AFRL **Information Directorate**

FACILITIES

Computing and Communications RIT Division
Information Systems RIS Division
Information Exploitation and Operations RIG Division
Information Intelligence Systems and Analysis RIE Division
Modeling and Fabrication Shops RIO Division


C4I & Cyber
Information Directorate
AIR FORCE RESEARCH LABORATORY

CONTENTS

Mission

To explore, prototype and demonstrate high-impact, game changing technologies that enable the Air Force and Nation to maintain its superior technical advantage.

Vision

To lead the Air Force and Nation in Command, Control, Communications, Computers, and Intelligence (C4I) and Cyber science, technology, research and development.


INFORMATION
N.Y.O
DIRECTORATE

C4 & Cyber
Information Directorate
AIR FORCE RESEARCH LABORATORY

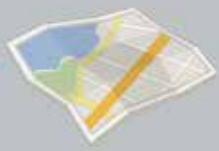
INFORMATION DIRECTORATE Campus

4 Buildings
At Rome Research Site

Newport
Off-site Facility

Stockbridge
Off-site Facility

65 Acre Campus
At Rome Research Site



30 Laboratories and Facilities

$1.6 B Facility Net Assets

882,000 sq.ft. Floor Space
At Rome Research Site

Computing and Communications

RIT Division Office

Putting the right information into the right hands at the right time.

MISSION STATEMENT

The Computing and Communications Division (RIT) leads the discovery, development and integration of affordable computing, networking, and communications technologies for our air, space and cyberspace forces.

Chief: Dr. Mike Hayduk
Deputy Chief: Greg Zagar
Technology Advisor: Dr. Mark Linderman

RIT DIVISION OFFICE PHONE: 315.330.3011

Advanced Computing Applications Laboratory

Supports various in-house projects using non-traditional computing technologies.

DESCRIPTION. The Advanced Computing Applications (ACA) Laboratory supports various in-house projects within the High Performance Systems Branch. Specifically, research performed in this facility consists of various non-traditional computing technologies.

EQUIPMENT/RESOURCES. Various type's of computer hardware from small single board embedded systems to high end workstations, including remote connections to the Air Force Research Laboratory Information Directorate (AFRL/RI), Affiliated Resource Center (ARC), and High Performance Computers (HPC). Also within the facility are various software defined radios utilized for wireless networking research.

CAPABILITIES. The type's of capabilities in the ACA Laboratory include, but are not limited to the following:

- Research, development and testing of wired and wireless distributed computing technologies
- Research, development and testing of specialized HPC technologies
- Electrical and mechanical integration of components and hardware into working systems or sub-systems; including Electrostatic Discharge (ESD) sensitive items and soldering of electronic components
- Preparation for and emulation of field experiments
- Software development
- Team meetings
- Tours and demonstrations
- Computer system administration (including systems in other facilities)

EXAMPLES OF CURRENT/PAST PROGRAMS. In-house accomplishments in this facility have supported various Office of the Secretary of Defense (OSD), Defense Advanced Research Projects Agency (DARPA), Air Force Office of Scientific Research (AFOSR) and Air Force Research Laboratory (AFRL) programs.

n-traditional

Controllable Contested Environment at Stockbridge

Multiple capabilities exist at this site including the Controlled Contested Environment (CCE) and the Small Unmanned Aerial System Experimentation Capability (SUAS-EC).

DESCRIPTION. The Stockbridge Experimental Facility is situated on 300 acres located 18 miles southwest of Rome. Multiple capabilities exist at the site including, the CCE and the SUAS-EC. The CCE consists of 25 remote locations, or "pads" spread across Stockbridge's 300 acres, configured to form a flexible outdoor "real world" experimental facility.

EQUIPMENT/RESOURCES. The 25 pads spread across Stockbridge's 300 acres provide shelter, power, antenna/towers, and fiber optic/network connectivity to a central building. Each pad consists of an S-280 shelter, two towers, and a variety of ancillary gear including antennas, power control, Internet Protocol (IP) network gear, Universal Software Radio Peripheral (USRP). Additional capabilities available within the environment include a wide variety of Radio Frequency (RF) signal generation as well as spectrum analysis. Future plans will augment those capabilities with additional resources. Reconfigurable laboratory space in the central building supports a wide range of experiments.

CAPABILITIES. The CCE provides a truly unique capability to support real world, outdoor and tactical edge experimentation for a wide range of information technologies. This flexible infrastructure supports the cost effective, rapid performance of experiments and tests in multiple technology areas, including RF communications, networking, cyber, and information. The environment includes the creation of a controllable 'contested' environment where RF transmissions and receptions can be completely controlled and measured. This enables research and development on the effects of dynamic spectrum access techniques, policy-based routing approaches, and cognitive network node performance in challenging environments.

EXAMPLES OF CURRENT/PAST PROGRAMS.

- **DSTO Australia Opal Experiment.** Experiments to validate semi-autonomous (user-on-the-loop) airborne enhancement of a distributed ground network.
- **Emitter Location with USRP's/Distributed Electronic Intelligence (ELINT) ground evaluation.** Emitter location measurements performed using a stationary emitter transmitting a signal waveform that is captured by multiple spatially separated sensor receivers, located at multiple remote pads.
- **EpiSys BioAI Algorithm Experiment.** Utilized multiple CCE pads to validate the performance of the BioAI algorithm, including network "tentacle", gap/hole repair, and interference mitigation.
- **ACE Research and Capstone Exercise.** VTOL UAS in Hardware-in-the-Loop simulation facilitated an exercise which made use of 10 distributed CCE pads.
- **MITRE High Frequency (HF) Mission-Oriented Investigation and Experimentation (MOIE) support.** Remote testing location utilizing the CCE to experiment with HF radios link to Bedford and Worchester, MA collecting a variety of sounding data.

Connectivity

Corporate Research and Development Facility (CRDSF)

Logical and physical connectivity requirements

DESCRIPTION. The CRDSF is an access controlled unclassified space hosting 63 racks in a American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE) Class I environment. The CRDSF connectivity infrastructure addresses logical and physical connectivity requirements, e.g. logical and physical isolation, or VLANs.

EQUIPMENT/RESOURCES. Equipment is customer/program supplied and maintained.

CAPABILITIES.

- ASHRAE Class I environment
- Conditioned and protected electrical service
- An unclassified controlled access server environment for Air Force Research Laboratory (AFRL) programs to expand capabilities and enhanced applied technologies

EXAMPLES OF CURRENT/PAST PROGRAMS.

- After Burner
- Collaboration Gateway (CG)
- Command and Control Concept Center (C2CC)
- Cyber Command and Control Test bed (C3T)
- Information for Operational and Tactical Analysis (IOTA)
- Independent Testing and Evaluation Center (ITEC)
- Web Enabled Temporal Analysis System – Tool Kit (WebTAS-TK)

nfrastructure

High Performance Computing – Affiliated Resource Center (HPC-ARC)

Includes CELL-BES system connected to the Secret Defense Research Network (SDREN). Providing tomorrow's Air Force with massively scalable HPC applications.

DESCRIPTION. Affiliated Resource Centers (ARCs) are DoD Laboratories and Test Centers that acquire and manage High Performance Computing (HPC) resources as a part of their local infrastructure, but share their HPC resources with the broader DoD HPC user community via a High Performance Computing Modernization Program (HPCMP) coordinated allocation of their HPC resources. In order to provide tomorrow's Air Force with massively scalable HPC applications, the software must be developed on large clusters. Unlike typical HPC clusters, all Air Force Research Laboratory Information Directorate (AFRL/RI) clusters allow for interactive development and testing.

EQUIPMENT/RESOURCES. The HPC-ARC has several super computers that have been designed, integrated and are operational.

- **CONDOR Cluster.** 500Tflop/s (DoD's Largest Interactive Super Computer): 84 Servers (2U Dual six-core Intel Westmere 5660, 24 or 48 GB RAM) each with 2 GPGPUs (nVidia C2050, C2070 or C2075s). The heterogeneous cluster has 22 PlayStation3® (PS3s™) connected to 78 of the server nodes (880 PS3s in total). The network consists of dual 10GbE and 40Gb/s infiniband, for enhanced I/O capabilities.
- **OFFSPRING Cluster.** 100Tflop/s (Dense Heterogeneous Computing): 18 Servers (1U – Xeon E5-2660 and E5v2690, (3) NVIDIA Tesla K20 GPUs, 128 GB RAM, 40GbE (Lustre 240TB), 56 Gb/s FDR Infiniband. Supports the Neuromorphic applications and runs the TrueNorth software development suite and compass emulator.
- **VULTURO.** Embedded HPC, 6U OpenVPX 18Tflop/s support the AirWASP flight test scheduled for June 2015. **5 Compute Nodes**. Compute Node (SBC625 3rdGen i7 quad-core & MXM940 Dual GK104 Kepler GPU). 6 GB Memory and IBX400 (Infiniband dual DDR-20Gb/s. Head Node-Compute Node (includes SBC625RTM). SATA 3.0 Disk (2TB), DVI, 6xUSB, VGA…I/O ports.

CAPABILITIES. **HPC-ARC(2).** ATO which will include the Owl Technology DIODE, allowing file transfers and streaming of UDP packets into the HPC-ARC real-time from Stockbridge Facility.

- **Visual Media Reasoning (VMR).** Supported the development, integration of the VMR Defense Advanced Research Projects Agency (DARPA) program, and hosted the system in the HPC-ARC.

  DREN ISP Benefit (300K/yr), the HPC-ARC DREN connection/DREN III (200Mb/s) and security assessment is covered by the HPCMP, the benefit to AFRL/RI is ~300K/yr. The total benefit since 1995 to the laboratory ~4.5M. In Fiscal Year 2016 a planned upgrade will be provided by the HPCMP office to DREN III (700Mb/s) at no cost to AFRL/RI.

EXAMPLES OF CURRENT/PAST PROGRAMS. AHPS & HPS, VMR, AirWASP, Secure COG, Computational Intelligence & Neuromorphic Computing, CRDF Autonomous Sensing Framework (ASF), StockBridge (High-Bay) Rapid-Link to HPC Experiments, FOPEN

Interactive

Microwave and Optical Communication Range

18 mile, line-of-sight communications capability available for microwave and optical over-the-air experimentation.

DESCRIPTION. The Microwave and Optical Communication Range is an 18 mile, line-of-sight communications capability available for microwave and optical over-the-air experimentation. Walk-up towers on each end of the link with heated and cooled experimentation rooms provide hands-on access of equipment and antennas. The first tower (Rome, NY) provides antenna mounting and workspace at 100 feet Above Ground Level (AGL), while the second tower (Stockbridge, NY) provides working levels at 60 and 120 feet AGL. Additionally, fiber connectivity to the ground provides remote control of equipment for long-term data gathering.

EQUIPMENT/RESOURCES.

- 100+ feet walk-up towers located in Rome, NY and Stockbridge, NY
- Heated and cooled experimentation rooms with direct access to equipment and antennas
- Spectrally quiet radio frequency environment for low-noise experimentation

CAPABILITIES.

- Long term data gathering
- Weather & atmospheric related analysis
- Far-field wireless communication link verification
- Flexible experimentation environment

EXAMPLES OF CURRENT/PAST PROGRAMS.

- RF Adaptive Persistent, Intelligence Surveillance and Reconnaissance (ISR) Data (RAPID) Link high-bandwidth backhaul
- Optical communication experimentation
- E-band long-term atmospheric analysis

Microwave

Nanotechnology and Computational Intelligence Laboratory

Research and development of unconventional computing architectures and paradigms.

DESCRIPTION. The Nanotechnology and Computational Intelligence Laboratory focuses on research and development of unconventional computing architectures and paradigms.

EQUIPMENT/RESOURCES. $1 Million laboratory possesses world class capabilities in nano device and neuromorphic based hardware characterization and testing.

CAPABILITIES.

- Probe station and parameter analyzer
- Cold-sample photoluminescence measurement system
- Circuit design, test, and evaluation
- Hardware neuromorphic computing architecture test and evaluation

EXAMPLES OF CURRENT/PAST PROGRAMS.

- Laboratory Research Initiation Request (LRIR) reservoir computing for process perception, prediction, and control
- LRIR understanding and analyzing entropy sources in metal oxide memristive devices for use in security primitives
- LRIR methods for developing secure nonlinear computer architectures
- In-house neuromorphic computing for very large test and evaluation data analysis

conventional

Network Centric Integration and Interoperability Facility (NCIIF)

The NCIIF includes network capabilities, computing platforms, network emulation and simulation, and RF/ optical communications capabilities.

DESCRIPTION. The Network Centric Integration and Interoperability Facility supports research and development, analysis and integration of a wide range of communications and networking technologies. It provides a flexible environment for a variety of work in emerging network centric capabilities. In conjunction with remote facilities at the Stockbridge test site, the NCIIF supports state of the art research, development and experimentation with network and communications related technologies.

EQUIPMENT/RESOURCES. 4600 sq. ft. facility is comprised of a main lab, and an adjoining facility used for radio and small Unmanned Aircraft System (UAS) work, as well as an antenna field on the roof of Air Force Research Laboratory Information Directorate (AFRL/RI) Building 3.

CAPABILITIES. The NCIIF includes network capabilities, computing platforms, network emulation and simulation, and RF/optical communications capabilities.

The facility has capabilities for test, evaluation, and development of communications networking, architectures and protocols. This includes real-time traffic generation, network monitoring, interface testing, and performance analysis capabilities for serial, T1, LAN, and Internet communications.

EXAMPLES OF CURRENT/PAST PROGRAMS.

- Tactical Wireless Connectivity (TWC)
- Assured Access Communications (AAC)
- Heterogeneous Operationally Responsive Networks (HORNets)
- Policy Enabled Coalition Communications (PECC)
- Advanced Network Computing Laboratory (ANCL) laboratory space
- Heterogeneous Integrated Network Technologies (HINT)
- Dynamically Self Tuned Performance Enhancing Proxy (PEP)
- Signals Intelligence (SIGINT) Experimentation
- Video Experimentation
- Integrated Netops Situational Awareness (SA) at the Tactical Edge (Office of the Secretary of Defense (OSD))
- Squadron Aviation Resource Management (SARM)/Tiberius, The Technical Cooperation Program (TTCP)
- Tactical Targeting Network Technologies (TTNT) (Defense Advanced Research Projects Agency (DARPA))
- Spectrum Analysis & Experimentation in Dynamic Environment (SADOE) (OSD)
- Dynamic Transport Protocols (OSD)
- Wireless Network after Next (WNaN), (Defense Advanced Research Projects Agency (DARPA))

Integration

Newport Research Facility

Newport Antenna Measurement Facility provides the Air Force a unique "far field, elevated" outdoor antenna test range.

DESCRIPTION. Newport Antenna Measurement Facility is located 30 miles southeast of Rome, NY. The facility is split between two hilltops; Irish Hill and Tanner Hill. The hilltops are separated by a distance of 1.5 miles with a 400 foot deep valley. These hilltops and the facilities on them provide the Air Force a unique "far field, elevated" outdoor antenna test range. The total facility consists of 78 acres with over 24,000 sq. ft. of laboratory, office, maintenance, and aircraft modification space.

The facility is also used to develop state-of-the-art antenna measurement technologies. Specifically techniques for measuring the effects of airframe features, including external weapons, pods and tanks, on aircraft antenna radiation patterns in a simulated flight environment. The data obtained can be used to characterize antenna performance of various aircraft configurations or to optimize the antenna to achieve specific performance levels.

Data collected at the Newport Facility can be done for a fraction of the cost of data collected via flight testing, and because these tests are repeatable to a very high level of accuracy, comparative testing between aircraft configurations or antenna designs can easily be accomplished. The airframes which are currently available for use at the Newport site include A-10, F-16 (A/C), F-15E, F-18 (A/C/E/F), F-22, F-35, SH-60, and sections of the B-1, KC-135, and C-130. Five-foot, 14-foot, and 40-foot ground planes are available and may be installed as required.

The Newport facility is comprised of five independent data acquisition facilities and eight measurement ranges. All ranges and both hills are interconnected with a multi-fiber optic network which interfaces to instrumentation and a high data rate link to a Wide Area Network (WAN) to Air Force Research Laboratory Information Directorate (ARFL/RI) at Rome, NY.

Measurement

EQUIPMENT/RESOURCES.

8 measurement ranges are fully instrumented with signal source, antenna, amplifiers, receivers, computers, displays, recording systems, fiber optic interfaces, positioner controllers, and high speed multiplex systems covering the frequency ranges of 50 MHz to 60 GHz. The ranges are typically operated with full-size airframes installed on special heavy-duty, high angular accuracy (+/-0.05 degrees), 3-axis positioners to accurately simulate all possible flight attitudes. Measurements of antenna radiation patterns are accomplished by illuminating the airframe with a uniform RF field at frequencies of interest. The airframe, with the test antennas installed, is then rotated to produce patterns of amplitude or phase versus azimuth angle or elevation angle:

RANGE 1 The Irish Range is situated across Tanner and Irish Hills. This range is 7520 feet long with a 400 foot valley in between. The primary transmit antenna sources located on Tanner Hill include four, six, eight, ten and twenty-eight foot parabolic dish reflectors. The receiver location is a 50 foot tower on Irish Hill. The receiver tower has a 3-axis positioner capable of holding full size vehicles weighing up to 50,000 pounds with an overturning moment of 300,000 foot pounds. This Irish Range is operated over a frequency range of 0.5-60 GHz.

RANGE 2 The Tanner Range is a 6700 foot range situated across Tanner and Irish Hills (with the 400 foot valley in between) and is utilized to obtain precision amplitude and phase patterns in the 0.5 to 18 GHz range with the added capability of VHF and Millimeter Wave measurements. The primary transmit antennas for this range are located at the transmit tower building on Irish Hill and consists of four, six, eight, ten, fifteen, and twenty-eight foot parabolic reflectors. The test airframes are mounted 60 feet above ground on Tanner Hill. This tower is capable of supporting full size test beds up to 10,000 pounds with an overturning moment of 75,000 foot pounds.

Please turn page for continuance of ranges and examples of current/past programs

Newport Research Facility *continued*

RANGE 3 The Site "X" Long Range is the primary F-35 range and is situated across Tanner and Irish Hills. This 5,500 foot range has a 400 foot valley between transmit and receive locations. This range is used to obtain antenna gain/amplitude and phase patterns on full size vehicles mounted on a 3 axis positioner capable of rotating up to 50,000 pound loads with an overturning moment of 300,000 foot pounds, in the frequency range of 2 to 18 GHz.

RANGE 4 The Site "X" Intermediate Range is set up for 1400 foot lengths with a 30 foot valley located on Irish Hill. The receive facility is remotely operated from Irish Hill. The transmit antenna consist of 8 and 15 foot parabolic reflectors, optimized for low side lobes, to cover the 0.5 to 2.0 GHz frequency range. The receive tower is a 50 foot tower with an SA Model 55850 3-axis positioner capable of rotating up to 50,000 pounds with an overturning moment of 300,000 foot pounds. Control of the positioner and receiver is remote via fiber optic cable to the Control Room. This range is used to obtain precision highly accurate amplitude/gain and phase patterns of antennas mounted on the various airframes at Newport.

RANGE 5 The Tanner Hill Short Range is a 750 foot flat range located on Tanner Hill. The transmit and receive facilities are collocated on the same hilltop. Transmit antennas, located in the short range facility, consists of two, four, six, eight, and ten foot reflectors mounted up to 30 feet above range level. This range has two, 3-axis positioners with a 10,000 pound capacity, one at each end of the range. This allows the range to be operated in both directions to accommodate special test requirements. This range is operated as both an elevated and a ground reflection range, as required, over the frequency range of 0.1 to 60 GHz.

RANGE 6 The Irish Isolation Range consists of a 20 foot tower with a 3-axis positioner capable of rotating 50,000 pound loads with a 300,000 foot pound overturning moment. The facility is used to mount full size vehicles for the purpose of measuring inter/intra system antenna isolation and coupling data. Although isolation measurements can be conducted at all locations, this range was specifically set up to allow the conduct of isolation measurement programs and free up the other ranges for pattern measurements, thus allowing more flexibility and productivity.

RANGE 7 Ground Reflection Range, 400' 30-500 MHz.

RANGE 8 Ground Reflection Range, 372' 30-500 MHz.

CAPABILITIES. Each range operates with a state-of-the-art automated Radio Frequency (RF) measurement system. Three networked and distributed computer systems based on the Linux operating system are used for real-time data acquisition, real-time operator graphical data visualization and RF transmitter control. The system provides extremely efficient and accurate RF measurements by providing high speed switching and multiplexing of antenna elements, RF frequency, transmit polarization and other parameters that may be required for the specific test program. Locally developed and maintained measurement system software provides the flexibility required for the measurement, control and monitoring of modern antenna systems. Data quality control is maintained with real-time and off-line graphical data visualization tools and anomaly detection software.

EXAMPLES OF CURRENT/PAST PROGRAMS. F-22, F-35, Multiple-Input Multiple-Output (MIMO), Ground-to-Air Transmit & Receive (GATR), ARR-72, B1-B, A-10, F-111A, AH-1, Cobra, F-4, F-16, F-15, F-18, KC-135, RADARNET, SHADOW.

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Radio Frequency Technology Center (RFTC)

A unique Electromagnetic Environment (EM) to conduct Radio Frequency (RF) systems and antenna systems integration, demonstration, test, and evaluations.

DESCRIPTION. The RFTC provides a unique electromagnetic environment to conduct RF systems and antenna systems integration, demonstration, test, and evaluations. The facilities supplement and support measurement activities at the remote Newport and Stockbridge Research Facilities.

The facilities consist of two EM anechoic chambers and associated RF sources, instrumentation, and support equipment. The two anechoic chambers (40'x32'x48' and 12'x12'x36') provide a free space EM for detailed antenna pattern measurements and evaluation of RF systems and interfaces. Systems as large as an Air Launched Cruise Missile (16 feet long) can be accommodated in the large anechoic chamber. The nearby Systems Demonstration Laboratory is available to be used in conjunction with the anechoic chamber facilities.

The Systems Demonstration Laboratory located in the RFTC is an RF and general purpose, multi-use, 5,628 square foot laboratory with electronic prototyping/repair benches, test equipment, instrumentation, network analyzer calibration area, software/hardware development area, equipment storage areas, and fully equipped machine shop area. The laboratory supports the development, integration and installation, test, evaluation, and analysis of breadboards, prototypes, and/or advanced development models (hardware/software) required to support various technical tasks. Furthermore, it supplements and supports measurement activities at the High Bay Anechoic Chamber Facilities and is used as a staging area to support demonstrations and field exercises at other locations. The laboratory has fiber optic connectivity to the inter-site microwave radio system from building 3 to the Stockbridge Research Facility and subsequently to the Newport Research Facility.

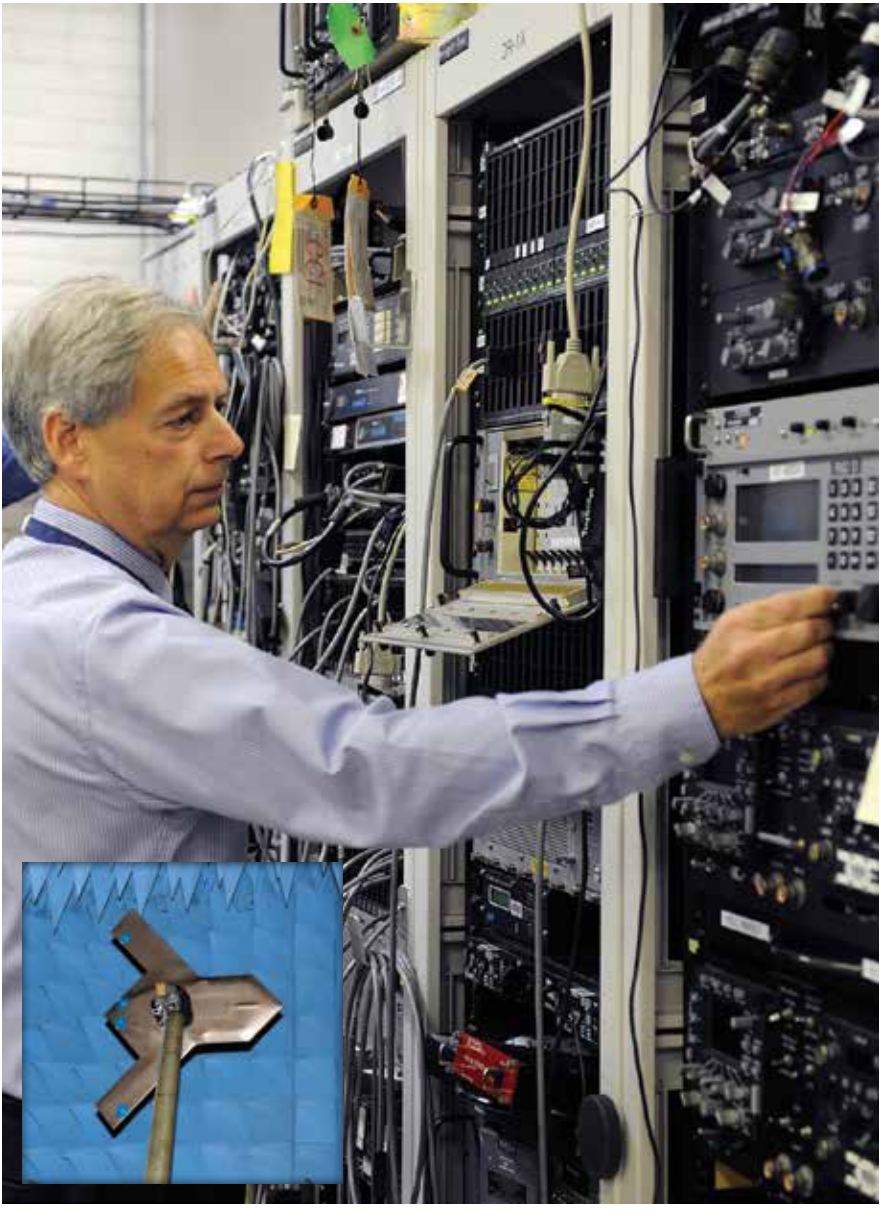
EQUIPMENT/RESOURCES.

- 2000 watt tetrode amplifier from 50 MHz to 200 MHz
- 1000 watt TWTs from 1 to 10 GHz
- 1000 watt pulsed amplifiers from 1-18 GHz
- RF synthesizers/generators
- Spectrum analyzers
- Network analyzers
- Power meters (pulsed & continuous)
- Automated Data Acquisition System
- Antenna positioner system
- Communications/radio sets
- Infrared Thermal Imaging System
- RF and microwave signal sources
- VHF/UHF, microwave, and millimeter wave antennas
- Video cameras/monitoring equipment
- Oscilloscopes
- Variable frequency "S" parameter vector network analyzer
- Frequency, voltage, current and resistance instrumentation
- Fiber optic telemetry equipment

CAPABILITIES. High average power densities of +21 dBm/cm2 (700 v/m), fully automated data acquisition and control systems, 50 MHz -18 GHz.

EXAMPLES OF CURRENT/PAST PROGRAMS. Remote radio, Network Modeling and Simulation Environment (NEMSE), Tactical Targeting Network Technology (TTNT), Rapid Link, distributed Signals Intelligence (SIGINT), wireless comm network architectures, network-centric exploitation and tracking, Quint (5) Network Technology (QNT), Multiple-in, and Multiple-out (MIMO) antennas.

ctromagnetic



Satellite Communications (SATCOM) Facility

The SATCOM facility supports the development and field testing of communications technologies.

DESCRIPTION. Because of its outdoor location and virtually unobstructed view of the Southern horizon, this area is optimally positioned to provide for convenient geosynchronous satellite access, as well as an un-interrupted, all-season view of the solar arc. The latter is required for passive radiometric measurements of solar radiation through the atmosphere in support of the development of atmospheric propagation models for future satellite communications at very high Radio Frequencies (RF), such as E-band (71 GHz to 86 GHz). This facility also provides test-bed support for atmospheric propagation testing for the development of free-space optical communications technologies.

EQUIPMENT/RESOURCES. Transmitters, receivers, radiometers, for Ka, X, E-band, optical, and Long Wavelength Infrared (LWIR). Recently added a multiband (X, Ku, Ka band) GMT and ground station SATCOM terminals which will allow new terminal technology testing, evaluation, and exercise support over operational DoD SATCOM networks.

CAPABILITIES. Testing of both RF satellite and optical communications technologies.

EXAMPLES OF CURRENT/PAST PROGRAMS. A number of satellite terminal in-house products have been developed in this facility. These include the Ka-band suitcase terminal, self-acquiring Ka-Band portable terminal for Federal Emergency Management Agency (FEMA), High Mobility Multipurpose Wheeled Vehicle (HMMWV)-mounted Ka-Band Comm-on-the-move (COTM) Terminal, and X-Band manpack terminals for U.S. Special Operations Command (SOCOM). A sun-tracking radiometer, E-band slant-path radio link, and weather data collection equipment are also on site to support E-Band atmospheric propagation studies for future SATCOM systems. Atmospheric propagation experiments at the short and long-wave (LWIR) bands are also being conducted at this site to develop future high-availability optical communication systems.

RF/Optical

Secure Embedded High Performance Computing

This facility is used for testing custom processor chips.

DESCRIPTION. 20 x 20 ft Electro Static Discharge (ESD) restricted area with 3 ESD benches, computer benches, and a conference table. It is used for testing custom processor chips.

EQUIPMENT/RESOURCES. Power supplies, 8 GHz digital oscilloscope, Field-effect transistor (FET) probes, standalone computers running Linux, custom processor chips, packages, and boards.

CAPABILITIES. Testing of ESD sensitive components using standard interfaces such as 10 Gigabit Ethernet Attachment Unit Interface (XAUI), and Joint Test Action Group (JTAG) test equipment.

EXAMPLES OF CURRENT/PAST PROGRAMS. The Secure Processor Version 1 chip as well as its package and board were debugged and demonstrated in this facility.

Processor

Small Unmanned Aerial System Experimental Capability (SUAS-EC)

The SUAS-EC provides a baseline centralized capability to operate a fleet of assorted, small Unmanned Aerial System (UAS) platforms.

DESCRIPTION. This capability supports Research & Development (R&D) by providing multiple, flight ready airframes, equipped with autopilot control, and all equipment necessary for flight test. The facility also provides trained personnel capable of performing flight test operations with these aircraft, and support to keep all aspects of the program compliant with flight test regulations. A flexible flight test/safety plan and approvals enables quick turn and cost effective experimentation for a multitude of Air Force Research Laboratory (AFRL) and customer programs.

EQUIPMENT/RESOURCES. Current inventory includes approximately 17 fixed wing SUAS platforms capable of carrying payloads up to 15lbs, 12 vertical takeoff and landing platforms (VTOL) (payloads up to 2.5 pounds), ground infrastructure and equipment to support airborne experiments with up to 4 platforms simultaneously. As well as trained personnel qualified to perform the duties of pilot, observer, ground station operator, and payload operator, along with qualified flight instructors and a flight examiner to maintain qualified and trained aircrews.

CAPABILITIES.

- Support a variety of SUAS flight experimentation, including fixed wing and VTOL
- A 16 square mile area surrounding the Stockbridge Test Site for flying at maximum altitudes of 2000 ft. Above Ground Level (AGL), and mobile capabilities to support testing in other locations
- Support for a wide range of experimental payloads, up to approximately 15 lbs. maximum. (payload capabilities vary by platform)
- Trained operators for a wide range of SUAS platforms
- Capabilities to perform integration of payloads, and all aspects of a flight test program
- Collocated with the Controllable Contested Environment (CCE)

EXAMPLES OF CURRENT/PAST PROGRAMS.

- **Defense Science and Technology Organization (DSTO) Australia Opal Experiment.** Multiple VTOL UAS to validate semi-autonomous (user-on-the-loop) enhancement of a distributed ground network.
- **Symbol-Level Link Prediction Experiment.** Fixed-wing UAS to collect link statistics during repetitive UAS flight by transmitting symbol-sized link probes from multiple transmitters onboard the UAS to receivers on the ground.
- **Sylvus StreamCaster (SC) Order Wire Experiment.** Two fixed-wing UAS and single ground node to validate SC Order Wire performance.
- **TCP Stockbridge Experiments.** Fixed-wing UAS to characterize/validate performance of Transmission Control Protocol (TCP) Stockbridge (in-House developed) algorithm.
- **Wireless Network after Next (WNaN) Flight Experiments.** Multiple fixed-wing UASs to validate function and behavior of networked radios.

Flight Test

Quantum Communications Laboratory (QCL)

Focused on integrating quantum data encryption and quantum key distribution with high data rate.

DESCRIPTION. The Quantum Communications Laboratory is focused on integrating quantum data encryption and quantum key distribution with high data rate, Free Space Optical (FSO) communications to reduced Size, Weight and Power (SWaP) for secure, high-capacity communication links. The atmospheric distortion inherent in the free space channel is compensated for by the use of Adaptive Optics (AO). The laboratory supports a stationary link from Air Force Research Laboratory Information Directorate (AFRL/RI) building 3 to the test site at Stockbridge Research Facility, a 30 km straight line distance. This link is used to characterize the atmospheric effects on the optical channel and correlate the environmental conditions with link performance. A scintillometer is collocated at the AFRL/RI site in Rome, NY with a transmitter positioned at the nearby high school, which serves as a convenient path given the scintillometer short range of operation. This convenience supplies high school students at Rome Free Academy (RFA) access to current research and weather measurements. The link also serves as a test bed for varying modulation schemes.

EQUIPMENT/RESOURCES.

- Tektronix OM4106D Coherent Lightwave Signal Analyzer
- High speed oscilloscopes
- Arbitrary waveform generation
- NuCrypt Alpha-Eta optical encoding system
- AOptix free space optical communication terminals with adaptive optics

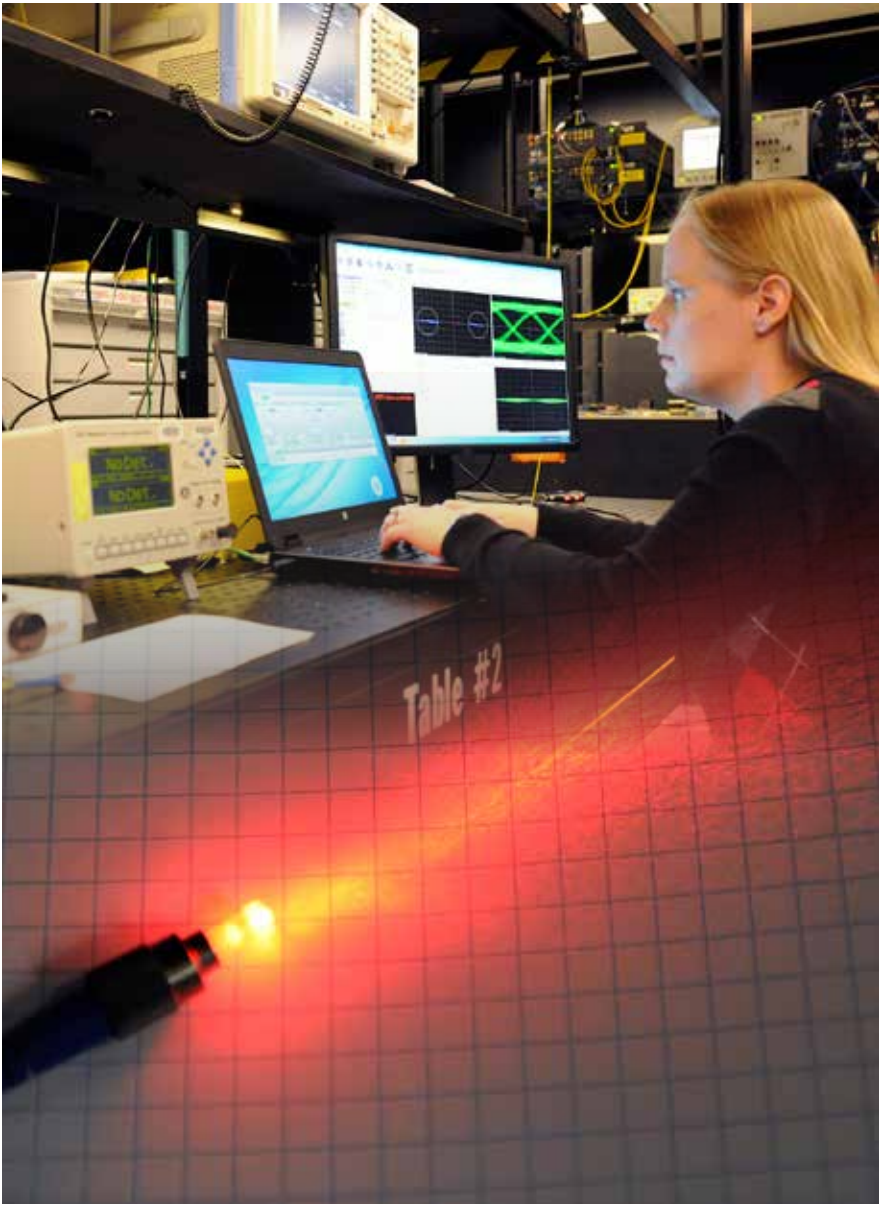
CAPABILITIES.

- Coherent signal analysis
- Secure optical communications
- Testing over a 30 km free space optical range

EXAMPLES OF CURRENT/PAST PROGRAMS.

- Secure high capacity information transport via optical wireless links
- Measuring quantum data encrypted modulation states

Secure



Quantum Information Science Laboratory

The goal is to construct systems that can perform secure and high efficiency data analytics.

DESCRIPTION. This one-of-a-kind in the Air Force Laboratory supports Research and Development (R&D) in the emergent field of quantum information science. The Air Force Research Laboratory Information Directorate (AFRL/RI) Quantum Information Science group focuses on research in linear optics quantum computing, quantum gates and circuits, quantum algorithms, quantum processor architectures, entangled photon generation, quantum cluster state generation, continuous variable cluster state generation, and quantum annealing. The overarching goal of all these research areas is to construct systems that can perform secure and high efficiency data analytics.

EQUIPMENT/RESOURCES. The 600 sq. ft. Class 4 laser facility contains continuous wave and pulsed lasers for conducting photon-based quantum experimental research implemented in bulk and integrated optics. The facility spans the gamut of photon based quantum computing with the ability to create photon quantum bits (qubits), entangle these qubits into larger quantum states, perform computation with these larger quantum states and analyze the output of the computation. The Quantum Information Science Laboratory has the capability to characterize and incorporate quantum waveguide integrated circuits into existing test beds as well as a complete set of classical (photon number >>1) and quantum (photon number ~1) measurement tools for these circuits.

CAPABILITIES.

- Single and entangled photon generation
- Single and entangled photon detection and measurements
- Optical chip probing
- Multi-wavelength photon analysis
- Quantum circuit testing and analysis

EXAMPLES OF CURRENT/PAST PROGRAMS.

- Quantum Information Technologies
- Quantum Compressed Sensing
- Integrated Quantum Photonic Circuits
- Quantum Entanglement Witnesses
- Cluster State Quantum Computing
- Advanced Quantum Test bed

Photon-based


WELCOME

Information Systems

RIS Division Office

Inventing technologies to realize truly integrated, resilient, and robust command and control systems.

MISSION STATEMENT

The Information Systems Division (RIS) leads the discovery, development, and integration of innovative technologies and systems that provide state-of-the-art, autonomy, integrated command and control, and information management technologies for Air Force and joint warfighters.

Chief: Julie Brichacek
Deputy Chief: Robert McHale
Technology Advisor: Richard Metzger

RIS DIVISION OFFICE PHONE: 315.330.4175

Black Room

Next-generation multi-purpose facility for research, demonstrations and presentations.

DESCRIPTION. The Black Room represents a next-generation multi-purpose facility for research, demonstrations and presentations. The facility offers a unique opportunity to bring high-end computer graphics resources and high-resolution displays into a shared and interactive space. It supports many demonstrations of Air Force Research Laboratory Information Directorate (AFRL/RI) technologies in a consolidated fashion and can provide a place and means for tight development integration with projects spanning many divisions and directorates.

EQUIPMENT/RESOURCES.

- Planar Clarity Matrix Video Wall with fourteen 55”-1920x1080 LCDs in a 7x2 matrix
- 2 Planar 55”-1920x1080 LCDs; 1 on each side of the video wall to display additional content
- 4 Ergonomic Workstations each with a 56”-3840x2160 LCD , and two 30”-2560x1600 LCDs
- Planar 84”-3840x2160 multi-touch LCD with passive stereoscopic 3D
- 12-core server-class computer w/ 4 NVIDIA Quadro K6000 graphics cards & 128GB memory
- 16-core server-class computer w/ 4 NVIDIA Quadro K5000 graphics cards
- Several workstation-class high-end graphics computers that are routable to the Ergonomic Workstations and Video Wall
- Evertz EQX Video Router configured w/90 inputs x 268 outputs; combination of fiber, coax, and Evertz X-Link high density interconnects; expandable to 576 x 864
- Evertz VIP Multi-Image Display Processor
- Polycom 1920x1080 VTC
- 5.1 channel audio system, table and lapel microphones, and audio mixer

CAPABILITIES. This cutting-edge environment currently integrates multiple technologies, including several high-end computer graphics workstations, a state-of-the-art video router with dynamically switchable hardware via fiber and copper interconnections, HD VTC, audio system, an 84” quad HD multi-touch screen that supports 3D viewing with passive stereoscopic glasses, and a high-resolution 27’ wide video wall with 14 times the resolution of a conventional 1080P HD screen. The facility also includes Ergonomic Workstations, in-house developed, portable, adjustable, multi-screen workstations to provide an unprecedented level of flexibility and reconfigurability.

EXAMPLES OF CURRENT/PAST PROGRAMS. Supports the Operational Assessment and Synchronized Operations Consolidated Programs, and UNITY an international agreement with the UK.

monstrations

Command and Control Technology Center (C2TC)

Develops advanced visualization and interactive displays.

DESCRIPTION. The C2TC supports research and development of advanced visualization and interactive displays, agents and machine-learning technologies, modeling and simulation including tools for managing uncertainty in causal models to achieve mission assurance in joint and combined military operations.

EQUIPMENT/RESOURCES.

- Data Wall: a 12' rear-projected system creating a seamless display surface of over 19.6M pixels
- 84" quad HD passive 3D multi-touch screen
- Real-time feeds of the National Air Space and Automatic ID System (water surface traffic)
- High end many-core workstations with 4k displays
- Developer workspace with access to Defense Research and Engineering Network (DREN) and Office Automation (OA) networks

CAPABILITIES. A modern software development environment with tools, data, computation and displays that provide a state-of-the-art set of capabilities and data for information visualization, modeling and simulation.

EXAMPLES OF CURRENT/PAST PROGRAMS.

- Research on graph visualization techniques
- Information discovery and exploration
- Research in storage, analysis, and dissemination of massive Point Cloud Data
- Research on massive point cloud level-of-detail and visualization
- Web based and thick client point visualization techniques
- Composable visualization research
- Cross-domain relaxed What You See Is What I See (WYSIWIS) visualization

Visualization

Command and Control Concept Center (C2CC)

Provides an environment to conduct system-level experimentation on information systems.

DESCRIPTION. The Command & Control Concept Center (C2CC) is a foundational capability for Air Force Research Laboratory Information Directorate (AFRL/RI), providing risk mitigation and developmental test capabilities for Advanced Technology Demonstrations (ATDs), Critical Experiments, and demonstrations. The C2CC provides an environment (emulated and/or simulated) to conduct system-level experimentation on information systems for not only C2, but connectivity and dissemination, and intelligence processing and experimentation.

EQUIPMENT/RESOURCES.

- Almost 1000 computers (laptops, desktops, and servers)
- Unclassified and classified research networks
- Classified computer laboratory (Secret Internet Protocol Router Network (SIPRNET), classified communications, safes, and cryptography)
- The following systems of record with accompanying data sets:
  - Theater Battle Management Core Systems (TBMCS) Force Level and Unit Level
  - Global Command and Control System (GCCS-J)
  - North Atlantic Treaty Organization (NATO) Integrated Command and Control (ICC)
  - Joint Warning and Reporting Network (JWARN)
  - Joint Effects Model (JEM)
  - Global Command and Control System (GCCS)-I3
  - Portable Flight Planning System (PFPS)
  - Command and Control PC (C2PC)
  - Joint Environmental Toolkit (JET)
  - Enhanced Maintenance Operations Center (EMOC)

CAPABILITIES. The C2CC provides AFRL/RI many research and development opportunities, including an evaluation laboratory used for fielding Command & Control (C2) systems of record and their related data sets. This facility is cleared to SECRET with access to SIPRNet.

EXAMPLES OF CURRENT/PAST PROGRAMS. Supported transitions of:

- Integrated Information Management System (IIMS)
- Synchronized Operations Demonstration
- Cyber Quantification assessment
- Space C2 demonstrations
- Trusted Network Environment (TNE)
- SecureView
- Information Support Server Environment (ISSE)
- AF Satellite Control Network
- Trusted Gateway System (TGS)
- Tactical ISR PED System (TIPS)
- Multi-level Thin Client (MLTC)

k Mitigation

K-5 Laboratory

Supports unclassified research and provides space, network infrastructure, and laboratory support.

DESCRIPTION. This RIS Division managed Laboratory is shared across the Air Force Research Laboratory Information Directorate (AFRL/RI) and supports RIS, RIG and RIE work units for Research and Development (R&D). The K-5 Laboratory only supports unclassified research and provides space, network infrastructure, and laboratory support.

EQUIPMENT/RESOURCES. The facility is not equipped to be a server room, but rather supports desktop computing research with network connections to server capabilities via Defense Research and Engineering Network (DREN) or Private Research Domain (PRD). Groups that work in the facility provide their own computers and software to conduct research and development.

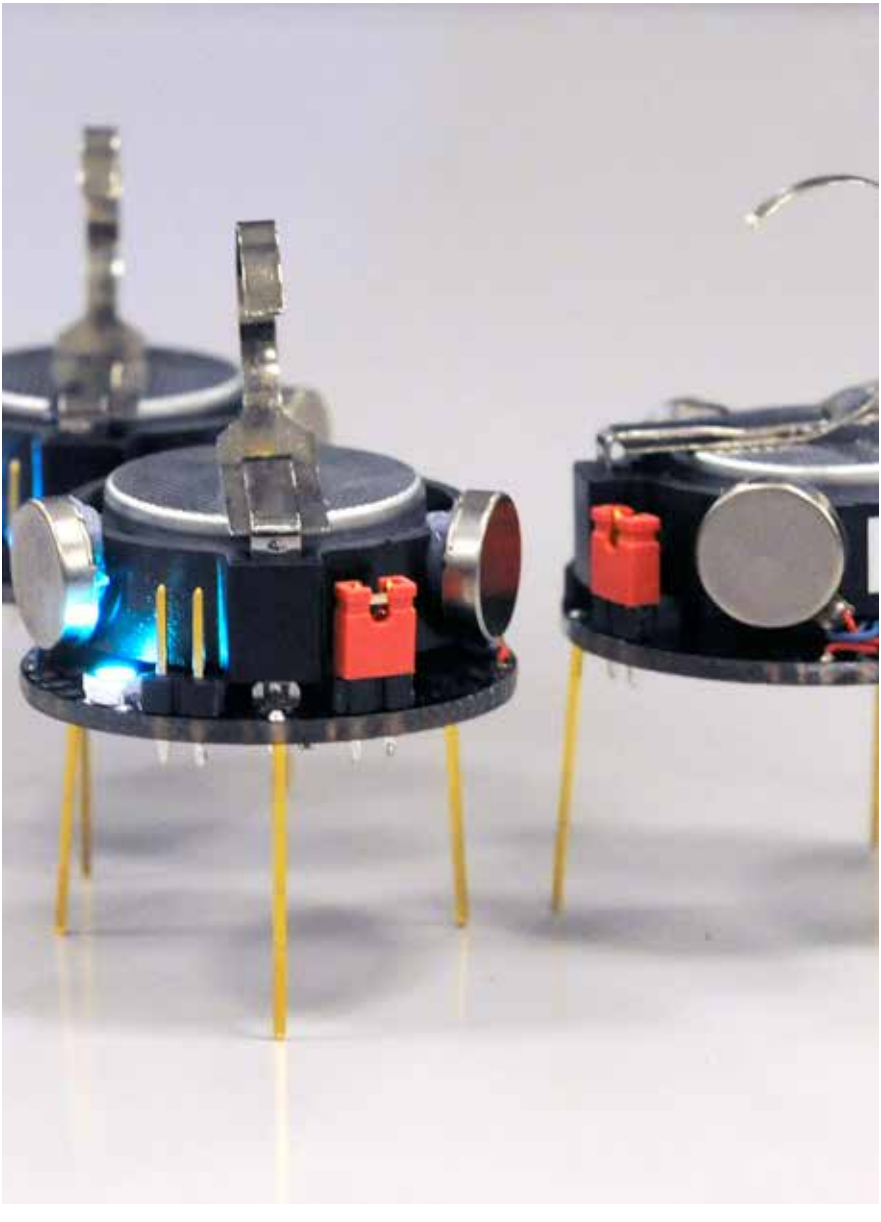
The facility does provide basic office infrastructure such as space, phones, chairs, desks, Two conference rooms, power, Office Automation (OA) and Defense Research and Engineering Network (DREN) printers, storage, etc.

CAPABILITIES. The facility provides 10 areas of space for unclassified in-house research to be conducted with seating for around 200 people. The space can be utilized to access networks such as PRD, DREN, or setup as standalone.

EXAMPLES OF CURRENT/PAST PROGRAMS.

- Integrated Information Management Systems (IIMS)
- Synchronized Operations Demonstration Support
- Mission-Aware Cyber Command and Control (MACC2)/Cyber Integration and Transition Environment (CITE) laboratory
- Machine Intelligence for Mission-focused Autonomy (MIMFA) in-house research
- Command and Control of Proactive Defense (C2PD) in-house research
- RIE R&D in audio processing and text extraction
- Network support staff

In-house



Operational Information Management (OIM) Facility — Research Development Test and Evaluation Enclave

Capabilities to research, develop, prototype, experiment, and demonstrate advanced information management technologies.

DESCRIPTION. The OIM Facility provides capabilities to research, develop, prototype, experiment, and demonstrate advanced technologies to address current and future Air Force Net-Centric information interoperability requirements to maximize the effectiveness of joint and combined military operations in both enterprise and tactical operational environments.

EQUIPMENT/RESOURCES. 30 workstation laboratory with various development environments including cloud-processing emulation.

CAPABILITIES. Research, develop, and prototype advanced information management technologies.

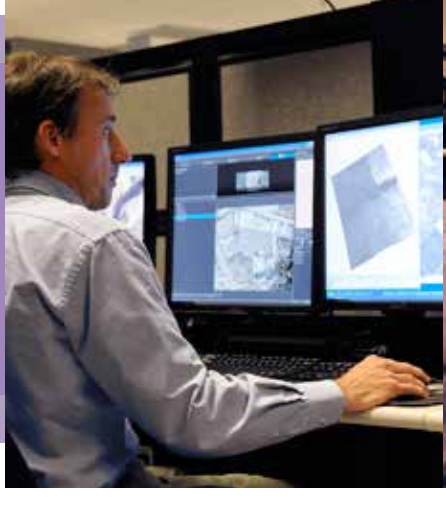
EXAMPLES OF CURRENT/PAST PROGRAMS.

- Phoenix Prime Information Management Middleware
- Marti Tactical Information Broker
- Open Pod Broker
- Android Tactical Assault Kit (ATAK)
- Responsive Information Prioritization and Relationships (RIPR)
- Synchronized Operations
- UNITY: Command and Control Synergy for Combined Operations
- Tactical Service Oriented Architecture

teroperability


AFRL
CYBER OPERATIONS
TECHNOLOGY FACILITY


CITE



Information Exploitation and Operations

RIG Division Office

Leveraging and shaping the cyber domain to the nation's advantage.

MISSION STATEMENT

The Information Exploitation & Operations Division (RIG) leads the research, development and integration of affordable information exploitation and cyber technologies for transition to our air, space and cyberspace forces.

Chief: Joe Camera
Deputy Chief: Robert Kaminski
Technology Advisor: Dr. Warren Debany

RIG DIVISION OFFICE PHONE: 315.330.4993

Audio Processing Laboratory

Conduct audio processing research and development initiatives from Technology Readiness Level (TRL) 2 – TRL 7.

DESCRIPTION. Air Force Research Laboratory (AFRL) provides the Audio Processing Group with laboratory areas at various classification levels to support research and development efforts in the tactical audio processing arena. The government and contractor team is co-located together to foster communication and seamless development. Research and development initiatives are conducted from Technology Readiness Level (TRL) 2 – TRL 7. The group works to provide algorithmic and software solutions that support operational requirements for off line based processing (pre-mission preparation and post-mission production needs), bulk processing (larger repositories of data), and real-time processing for streaming audio.

EQUIPMENT/RESOURCES. The unclassified laboratory is outfitted with Defense Research and Engineering Network (DREN), Air Force Network and a standalone network to support algorithm and software development. The laboratory includes several servers with multiple multi-core processors, a GPU server for testing GPU-based algorithms, and a single-core system for benchmarking algorithm performance. These servers are housed in a large server facility managed by the Computing and Communications (RIT) division.

Numerous pieces of collection equipment exist in the laboratories to support data requirements for algorithm testing. This includes two audiometric rooms, various types and styles of microphones, transmitters, receivers and analysis equipment.

The laboratories each support various development environments for cross platform software solutions. Replicas of various operational environments are housed in the laboratories in order to support customer work.

The laboratories test equipment allows the verification of the integrity of collection configurations, as well as producing analysis of audio streams in real time. A large collection of audio data is maintained that can be modified to fit the needs of most audio processing projects. The laboratory also hosts team collaboration and communication software such as JIRA and Confluence to document meetings, schedules, findings and documentation.

CAPABILITIES. An audio processing test bed was created to support the creation and evaluation of our algorithms as they progress through TRL levels.

EXAMPLES OF CURRENT/PAST PROGRAMS. Algorithmic developments and software demonstration deliveries have been delivered under the Military Intelligence Program, Tactical Signals Intelligence (SIGINT) Technology Program, Air Force Compass Bright Program, The FAVOR-DLIPS-IDEAS* Program, and the Forensic Audio, Video, and Image Analysis Unit (FAVIAU) Program. Featured algorithm development has consisted of work on speaker and language identification, speech enhancement and detection of signals of interest.

*FAVOR - Foreign Audio and Video Operations
DLIPS - Digital Language and Image Processing System
IDEAS - Integrated Discovery, Exploitation and Analysis Services.

Speech

Corporate Collateral Facility (CCF)

A secure facility that supports cyber operations work as well as associated information system(s) use.

DESCRIPTION. A secure facility that supports classified briefings, video teleconferences, testing, document creation (editing), experimentation concepts, data analysis, software development, and exercises as well as associated information system(s) use. The Corporate Collateral Facility is used by all of Air Force Research Laboratory Information Directorate (AFRL/RI) and is maintained by the RIG division.

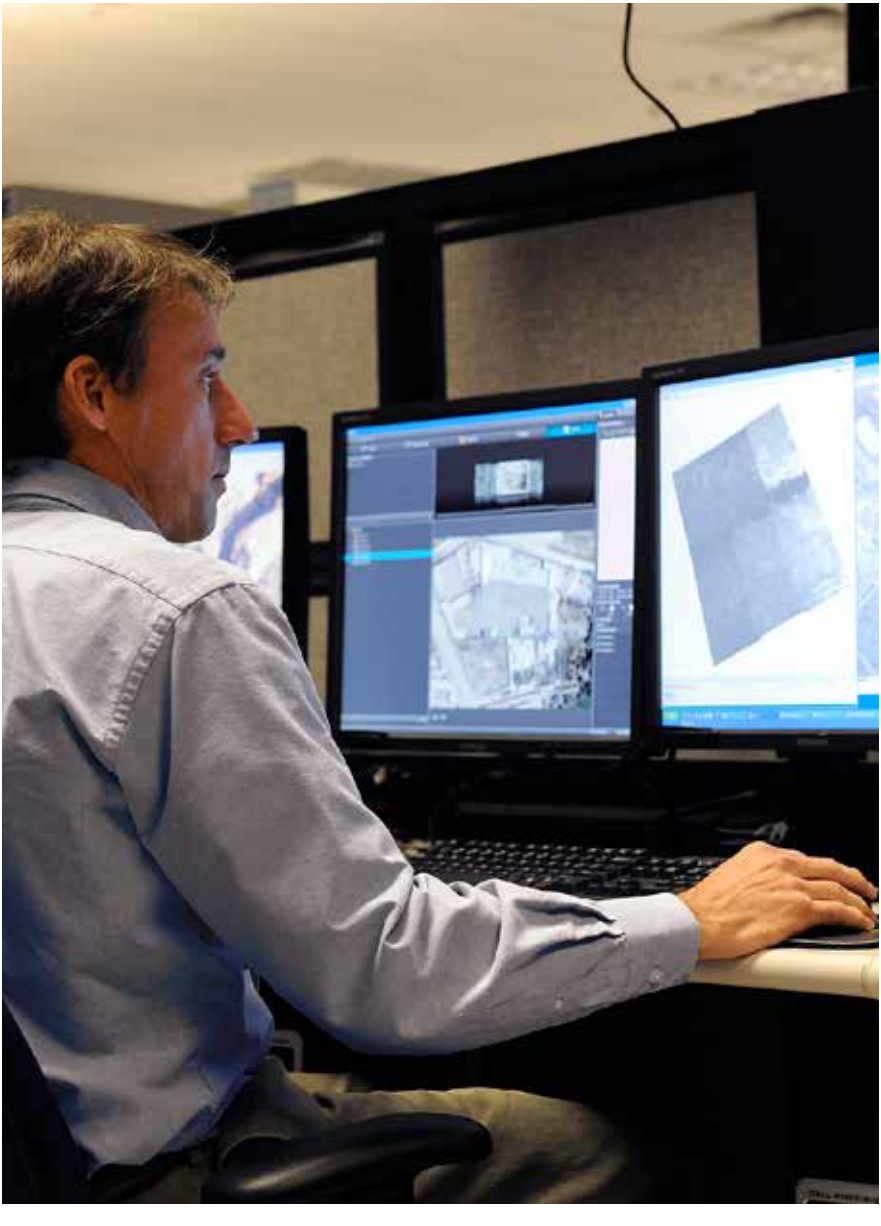
EQUIPMENT/RESOURCES. Information systems support, software license management support, access control, secure phone communications, secure video teleconferences, secure e-mail (SIPRNET), secure web browsing, scheduling (Test bed calendar); auditorium (70 seat), secure meeting spaces.

CAPABILITIES. The facility provides AFRL/RI personnel a dynamic environment for collaborative research and development efforts. The facility is comprised of multiple systems and networks (i.e. Secret Internet Protocol Router Network (SIPRNET), Defense Research and Engineering Network (DREN), and standalone), to include data sources for accomplishment of research and development activities for integration and demonstration of state-of-the-art technologies.

EXAMPLES OF CURRENT/PAST PROGRAMS.

- Audio Exploitation technology
- Intelligence, Surveillance and Reconnaissance (ISR) technology
- Signals Exploitation technology
- Steganography technology
- High Performance Computing (HPC) technology
- Communications Intelligence technology
- Information Management technology
- Imagery Intelligence technology
- Embedded Systems technology

r Operations



Cyber Experimentation Environment (CEE)

Fosters technology transition to the warfighter, and conducts research associated with experiment automation.

DESCRIPTION. The Cyber Experimentation Environment (CEE) is a nationally acclaimed, state-of-the-art, cyber Research and Development (R&D) environment that enables Information Operations experimentation, fosters technology transition to the warfighter, and supports research associated with experiment automation. It is used by Air Force Research Laboratory Information Directorate (AFRL/RI) for Independent Validation and Verification (IV&V) of emerging cyber technologies. Advances in automated experimentation have been directly applied to a large number of non-trivial classified experiments; these experiments rest on a scientific method that applies practical metrics in the context of a carefully constructed, automatically generated, ground truth. As DoD cyberspace operations converge towards full spectrum (i.e. leveraging electro-magnetic capabilities), CEE will evolve its own experimentation capabilities and testing methodologies to incorporate these advances.

EQUIPMENT/RESOURCES. The CEE consists of a hardware and software framework that rapidly configures large-scale and distributed range architectures that facilitates experimentation with both offensive and defensive cyber technology in realistic commercial and military settings. CEE leverages existing AFRL investments through co-location and use of other facilities such as the Corporate R&D Server Facility and Stockbridge/Newport test sites.

CAPABILITIES. CEE has established connectivity with external mission partners and military organizations. Additional persistent connections have been established with the Advanced Technology Laboratory (ATL) at Lockheed Martin (Arlington, VA) and MIT's Lincoln

Range

Laboratory (Lexington, MA) to aid in streamlining development and integration of highly automated software tools. Through a combination of AFRL/RI and customer funded R&D efforts, CEE has produced a suite of software comprised of best of-breed technologies to enable large scale cyber effects. This includes: Lockheed Martin Advanced Technology Laboratories (ATL) Dynamic Automated Range Technology (DART), MIT Lincoln Laboratory's Lincoln Adaptable Real-time Information Assurance Test bed (LARIAT), AFRL/RI's JVIEW and Range Automation Configuration Engine (RACE) technology. RACE in and of itself is a culmination of over a dozen custom in-house tools that enables seamless integration of the entire toolkit and one-click experiment execution.

CEE has expanded its user and customer base by relocating its primary "base-of-operations" to an unclassified lab space. This enables greater collaboration amongst external partners, as well as increasing the pace of tool development due to additional unclassified resources. Additionally, in order to scale resource management and provide experimentation capabilities concurrently to multiple programs, CEE was re-established as a notional hardware/software framework and architecture that is distributed and deployable.

CEE technological advances enable offense on-defense experimentation, using practical metrics, with the heavy use of automation to provide scalability, realism (hardware-in the-loop), situational awareness, network complexity, diversity, measurement, and analytics. Steady investments and improvements to range automation tools have sharply reduced the manpower required to conduct experiments; the minimum essential staff needed to stage and execute an experiment is one system administrator and one programmer. Improved automation techniques also drastically reduced range build times for large-scale complex experiments from months to days.

Please turn page for programs and customers supported.

Cyber Experimentation Environment (CEE) *continued*

EXAMPLES OF CURRENT/PAST PROGRAMS. Large-scale experiments combining diverse, virtual, and bare-metal systems that provide technology evaluations and performer feedback leading to enhanced cyber technologies in the following areas (most recent, Fiscal Year 2014-Present):

- **Cyber Agility Program:** In-house developmental testing and experimentation into large scale Moving Target Defense (MTD) deployments and interoperability
- **Steganalysis Experimentation:** Scalability testing of steganalysis techniques
- **Metasponse Scalability Testing:** Developmental testing in support of Firestarter funded Metasponse toolkit used by Blue forces
- **Siege Technologies:** Advanced metric definitions

Throughout the course of CEE's lifespan, experiments have been conducted with RIE, RIS, RIG, AFRL/Human Effectiveness (RH), National Geospatial- Intelligence Agency (NGA), 46th Test Squadron, Air Force Life Cycle Management Center (AFLCMC), and 346th Test Squadron. In prior years, CEE has been co-funded by AFRL/RI and Assistant Secretary of Defense for Research and Engineering (ASD R&E). AFRL/RI funded the experimentation and ASD R&E funded the Science and Technology (S&T).

C4 & Cyber
Information Directorate
AIR FORCE RESEARCH LABORATORY

Cyber Integration and Transition Environment (CITE)

A collaborative workspace for conducting cyber-related research and development.

DESCRIPTION. The Cyber Integration and Transition Environment (CITE) is a collaborative workspace for conducting defensive cyber-related research and development, from proof of concept (6.1) through advanced prototyping (6.3). The core focus of CITE is to provide a targetable transition platform for technology maturation and operational acceptance by leveraging partnerships with key agencies that support Air Force Network Operations (AFNETOPS).

Representing the Air Force network at the appropriate level of fidelity is challenging and deciding what can be emulated, simulated, virtualized, or requires actual hardware is an ongoing effort. Along with focus on discovering, developing, and maturing defensive cyber technologies, CITE is used to address Test and Evaluation (T&E) methods. As a workspace focused on Cyber Defense, the laboratory must represent real world Air Force systems without requiring the manpower and resources necessary for an actual real world system. This challenge is also faced by Life Cycle Management Centers (LCMCs) and Test and Evaluation (T&E) organizations. CITE supports multiple operating systems, high Technology Readiness Level (TRL) systems, representation of multiple Air Force enclaves and the network between those enclaves.

CITE provides a low cost and rapid environment for early T&E of defensive cyber capabilities in preparation for more extensive evaluations with the T&E community.

EQUIPMENT/RESOURCES. Scalable and feature-rich environment consisting of isolated and interconnected test beds, configuration management, and enterprise services.

CAPABILITIES. Test and evaluation at Technology Readiness Level (TRL) 6 of integrated cyber capabilities.

EXAMPLES OF CURRENT/PAST PROGRAMS.

- Firestarter programs
- Mission Aware Cyber Command and Control (MACC2)

Partnerships

Cyber Operations Technology Facility (COTF)

A secure facility that supports cyber operations work as well as associated information system(s) use.

DESCRIPTION. A secure facility that supports classified briefings, video teleconferences, testing, document creation (editing), experimentation concepts, data analysis, software development and exercises, as well as associated information system(s) use. The facility is a corporate facility used by all divisions and maintained by the Information Exploitation and Operations (RIG) division.

EQUIPMENT/RESOURCES. Information systems support, software license management support, access control, secure phone communications, secure video teleconferences, secure e-mail (Secret Internet Protocol Router Network (SIPRNET)), secure web browsing, scheduling (Test bed calendar); Conference Room (10 seats), secure meeting space (demonstration area).

CAPABILITIES. The COTF provides Air Force Research Laboratory Information Directorate (AFRL/RI) personnel a dynamic environment for collaborative research and development efforts. The facility is comprised of multiple systems and networks (i.e. SIPRNET, Defense Research and Engineering Network (DREN), and standalone), to include data sources for accomplishment of Research and Development (R&D) activities for integration and demonstration of state-of-the-art technologies. The core focus of this facility is Cyber Operations Technology.

EXAMPLES OF CURRENT/PAST PROGRAMS.

- Mission Centric Cyber Assurance
- Cyber Agility
- Cyber Survivability & Recovery
- Mission Aware Cyber Command and Control (MACC2)
- Large Data Implementation
- Ruby Slipper (Cyber Mission Framework)
- Cyber Experimentation Environment

*Construction was completed for this facility in April of 2014. Communication systems continue to be installed as well as accredited. Programs and projects continue to move to this renovated facility and the user base will significantly increase throughout Fiscal Year 2015.

...te-of-the-art


AFRL
THE AIR FORCE RESEARCH LABORATORY
CYBER OPERATIONS
TECHNOLOGY FACILITY

Imagery Exploitation

Experimentation and evaluation of large scale data exploitation and correlation techniques.

DESCRIPTION. The Imagery Exploitation facility supports experimentation and evaluation of large scale data exploitation and correlation techniques with a focus on the needs of the Intelligence Community (IC). IC and Department of Defense (DoD) standard software architectures and standards are maintained as an integral part of the environment. Large data holdings are maintained as part of this facility, including National Geospatial-Intelligence Agency (NGA) reference products, operational Full Motion Video (FMV) data, truth data, and intelligence products. Various software applications and services are maintained. Internally and externally developed software is tested and evaluated in this operationally relevant environment. A current focus is the testing and evaluation of video object search for the Persistent Surveillance Signatures Analysis (PSSA) project.

EQUIPMENT/RESOURCES. A standalone network that provides desktop workstations and rack servers for testing and evaluating exploitation software. Currently there are 4 desktop workstations, 2 high-end Windows 7 workstations and 2 mid-tier Windows XP workstations. The server cluster includes a 48 TB storage server and a Blade server enclosure with 6 Dell servers. The servers and workstations are connected via gigabit Ethernet in a standalone network configuration. In addition there is a collection of NGA standard geospatial data product CDs.

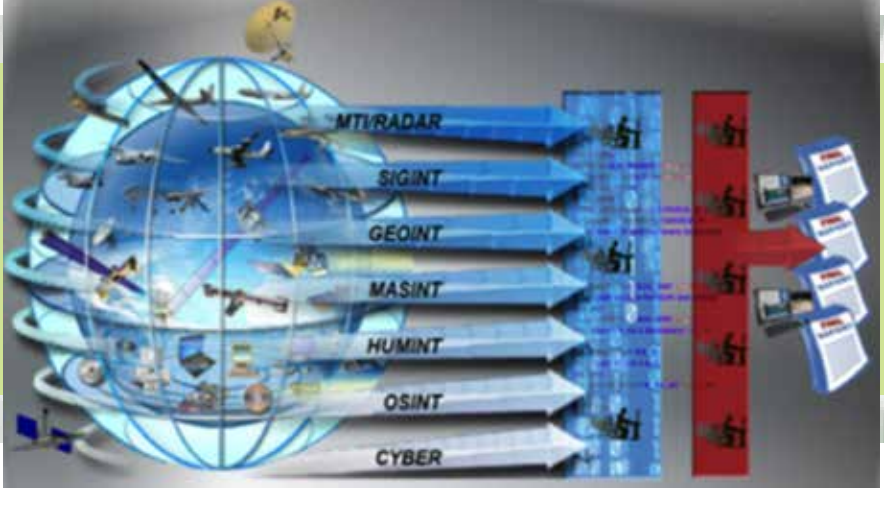
CAPABILITIES. Test bed and demonstration environment for imagery and Multi-Intelligence (multi-INT) exploitation tools. Recently, in support of the Persistent Sensor Storage Architecture (PSSA) project, a Full Motion Video (FMV) object search test bed was stood up, which includes operational FMV, a truthing tool (VIPER), and vendor software.

EXAMPLES OF CURRENT/PAST PROGRAMS.

- Signatures Exploitation
- Persistent Surveillance Signatures Analysis
- Motion Imagery Visualization
- Integrated Exploitation.

Multi-INT


OFFICE OF THE DIRECTOR OF NATIONAL INTELLIGENCE
UNITED STATES OF AMERICA


MTI/RADAR
SIGINT
GEOINT
MASINT
HUMINT
OSINT
CYBER

Information Intelligence Systems and Analysis

RIE Division Office

The computing and algorithms behind transforming big data into information.

MISSION STATEMENT

The Information Intelligence Systems and Analysis Division (RIE) leads the discovery, development, and integration of affordable products addressing intelligence community technology requirements for our air, space, and cyberspace force. The Division also conducts selected acquisition programs for low-volume, limited quantity systems for the intelligence community.

Acting Chief: Michael Wessing
Deputy Chief: Michael Wessing
Technology Advisor: Jon Jones

RIE DIVISION OFFICE PHONE: 315.330.2976

Automated Processing and Exploitation (APEX) Center

Understand, measure, and advance state-of-the-art with technology.

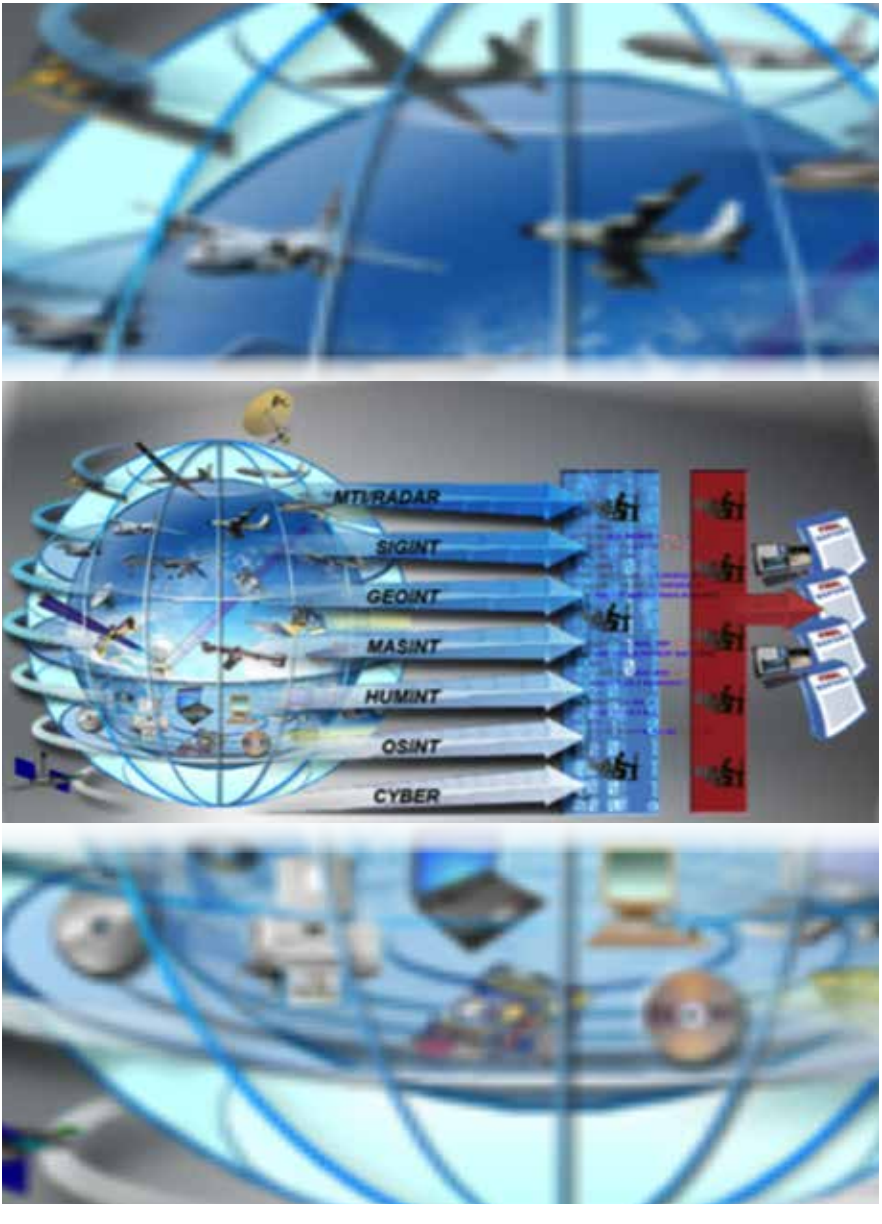
DESCRIPTION. Established in 1996, the overall mission for the APEX Center is to understand, measure, and advance state-of-the-art primarily with Processing and Exploitation (PEX) technology. The current focus is on Motion Exploitation and Activity Based Intelligence. The facility is also used to perform analysis for seedling (Defense Advanced Research Projects Agency (DARPA) and other) efforts, baseline tool development for major programs, and to provide realistic operational systems, networks, and databases for integration efforts. The APEX Center can act as an Intelligence Systems Integration Laboratory (ISIL) and is currently being established to address current and future challenges in the following areas: Planning & Direction, Collection, Processing & Exploitation, Analysis & Production, Dissemination and Integration Experimental (PCPAD-X, a cross directorate AFRL Initiative), Air Force Distributed Common Ground System (DCGS) challenges as identified by the Air Force Intelligence, Surveillance, and Reconnaissance Agency (AFISRA), and the Remotely Piloted Aircraft (RPA) Squadron Operations Center (SOC).

EQUIPMENT/RESOURCES. With over 175 computers, including two large compute clusters (1,680 Intel cores, 46,080 GPU cores, 400TB of storage, and 6TB of memory), the APEX Center resources are substantial. It is primarily operating at a classified level on multiple networks, but includes systems, capabilities, and development environments on unclassified systems too, including Defense Research and Engineering Network (DREN). The Center also includes connectivity to coalition partners. The equipment in the facility has a value of $1.9 Million, and is 3,240 sq. ft. in size. It holds over 20,000 operational mission data sets from various Intelligence, Surveillance and Reconnaissance (ISR) platforms, including over 2 years of video (24 X 7) and global Situational Awareness data (Force XXI Battle Command, Brigade and Below (FBCB2), Electronic Intelligence (ELINT), Federal Aviation Administration (FAA), etc.) live data is available from a myriad of operational sensors.

CAPABILITIES. The area includes a test bed within which Air Force Research Laboratory (AFRL) can define metrics, develop standards, integrate, evaluate, and demonstrate technologies to support and facilitate the processing, exploitation and dissemination of data from a variety of sensors. The capability is used to support analytical studies, on-site and network distributed simulation exercises, and the processing of real-world, Multi-Intelligence (multi-INT) data. The APEX Center efforts facilitate Research and Development (R&D) across a broad area of Command and Control (C2) as well as ISR. All applicable INTs are investigated with emphasis on Ground Moving Target Indicator (GMTI), ELINT, Signals Intelligence (SIGINT) and Measurement and Signatures Intelligence (MASINT).

EXAMPLES OF CURRENT/PAST PROGRAMS. Integrated Tracking, Analysis & Discovery (ITAD), C4ISR (Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance) Enterprise to the Edge (CETE), Enhanced Exploitation and Analysis Tools (E2AT), Text Analysis, Full Spectrum Targeting (FST), Secure Multi-Domain Collaboration, Automated Indications and Warning (AI&W), Afterburner, Machine Intelligence for Mission Focused Autonomy (MIMFA), PCPAD-X.

Intelligence



Integrated Intelligence Innovation Facility (I3F)

Provides end users hard hitting future technology to meet warfighter requirements.

DESCRIPTION. The I3F enables information handling research, development, integration, test and evaluation of solutions for Air Force, Department of Defense (DoD) and Intelligence Community (IC) secure information sharing and analytic requirements. This facility enables delivery of Cross Domain Information Sharing solutions Science and Technology programs and operational cross domain information sharing and analytic capabilities that are currently deployed across the Air Force, DoD and the IC. Additionally, operational Information Handling branch (RIEB) programs are supported with integrated organic product support functions (e.g. incident reporting management, software configuration management) delivered from the facility.

EQUIPMENT/RESOURCES. The facility contains a direct attached 300 square foot unclassified mini data center with dedicated cooling and power. Additional connectivity to the Air Force Research Laboratory Information Directorate (AFRL/RI) corporate consolidated server environment that enables the rapid horizontal scalability to address wide ranging and complex operationally relevant environments. The laboratory area contains hundreds of compute end-points deployed on a wide variety of heterogeneous platforms that include various thin clients (with associated Virtual Desktop Infrastructures (VDI)), thick client (x86 and SPARC), various monitor setups to emulate operations center configurations, and a high performance teaming room to support in situ technology planning, integration and Test and Evaluation (T&E).

CAPABILITIES. The I3F enables RIEB research, development, integration, T&E of solutions for Air Force, DoD and IC secure information sharing and analytic requirements. It's capability to emulate operational environments at simulated multiple levels of security is critical to delivering real technology capability on-time to our customers.

EXAMPLES OF CURRENT/PAST PROGRAMS.

- SecureView multi-level access system
- Information Support Server Environment (ISSE) cross domain transfer system
- Collaboration Gateway (CG) cross domain chat system
- Voice and Video Cross Domain Solution (V2CDS)
- Cross Domain Information Sharing (CDIS) research projects
- SABER multi-level access system
- Lifecycle Engineering and Technical Support (LETS)

Cross domain

Intelligence Community, Automated Information Systems (IC AIS) Laboratory

The Intelligence Community Automated Information Systems (IC AIS) Laboratory is a Sensitive Compartmented Information Facility (SCIF) that supports classified work as well as associated information system(s) use.

DESCRIPTION. All SCI Video Tele-Conference (VTC), telecommunications, briefings and presentations, desktop processing, data search and retrieval, document creation, software development, testing, and operations that occur at the Air Force Research Laboratory Information Directorate (AFRL/RI) depends on the essential services provided in this classified facility. Every AFRL scientist, engineer, manager or contractor that enters this facility conducts business with intelligence products, services, or systems.

Dependent on the resources and capabilities that are required, the Special Security Office (SSO) within the facility provides an environment for research, development and communications with various Intelligence agencies.

EQUIPMENT/RESOURCES. The facility houses software and data storage models at the SCI level for service to the Intelligence Community.

CAPABILITIES.

- AFRL scientists, engineers, managers and Government contractors utilize the Sensitive Compartmented Information Facility (SCIF) for various functions including access to computer or network resource to include briefing systems, secure VTCs, and Voice over Internet Protocol (VOIP) telephones.
- The AFRL/RI Final Technical Report Repository provides researchers, scientists, and engineers timely access to restricted SCI publications covering several collection subject areas. The focus of this repository is to support the nation's warfighter in intelligence gathering.
- Research and Development (R&D) and Technology Conferences are hosted within the facility to foster collaboration among the various Intelligence organizations.

Intelligence

Machine Intelligence for Intelligence, Surveillance, and Reconnaissance (ISR) Laboratory

Methods for autonomous collection and information processing.

DESCRIPTION. The Machine Intelligence for ISR Laboratory provides an environment for research scientists and engineers to develop, simulate, and evaluate methods for autonomous collection and processing of Intelligence, Surveillance, and Reconnaissance (ISR) information. The in-house team and support contractors have a wide range of expertise, including machine learning, data mining, multi-agent coordination, and discrete-event simulation. This facility is closely integrated with the Machine Intelligence for Mission Focused Autonomy (MIMFA) program, developing autonomous technologies for the entire lifecycle of the ISR process. Collaborators from academia as well as summer students also use the facility to conduct research.

EQUIPMENT/RESOURCES.

- Linux Desktop Computers: 5
- Flat Panel Monitors: 10
- Laptop Computers: 5

CAPABILITIES.

- Development of new algorithms to support human-machine and multi-robot teaming for ISR scenarios and vignettes
- Multi-tiered simulation testing and development for metrics-based validation and verification
- Technology integration

EXAMPLES OF CURRENT/PAST PROGRAMS.

- **Autonomy Test and Evaluation Environment (ATE2):** Developing a simulation environment that allows for emulation of virtual entities that can interface with real-world robotic platforms. ATE2 provides mechanisms for researchers to implement single or multi-agent algorithms with abstraction away from the hardware. Successful implementation in this environment provides a stepping stone to executing on physical platforms.
- **Multi-Unmanned Aerial Vehicle (UAV) Coverage under Uncertainty:** While significant progress has been made in generating optimal coverage for collection locations, these methods are not intended to be robust against imminent threats in the environment. We are developing new methods for resilient ISR collection in contested threat environments.
- **Learning from Imbalanced Data:** Real world collection often results in data that is heavily imbalanced, providing a challenge for classification. This work investigates methods for extracting actionable knowledge from imperfect data sources, improving our ability to perform ISR in contested environments where no pre-processing of data is available.

Collection

Situation Awareness (SA) Laboratory

Perform research and development of technologies to conduct unbiased evaluations of Text Analysis and Network Discovery technology products and resources.

DESCRIPTION. The Situation Awareness (SA) Laboratory provides an environment for research scientists and engineers to evaluate, demonstrate, and develop software based capabilities and perform basic research. The in-house team and support contractors perform Research and Development (R&D) of technologies utilizing a suite of in-house hardware/software tools and conducts unbiased evaluations of Text Analysis and Network Discovery technology products and resources. This includes existing Air Force Research Laboratory Information Intelligence Systems and Analysis (AFRL/RIE) contractor products as well as outside commercial applications. This corporate in-house capability is vital in providing functional and valuable products to the Department of Defense (DoD) and Air Force Intelligence Communities. Collaborators from the Information Systems (RIS) division as well as summer students use the facility to conduct research.

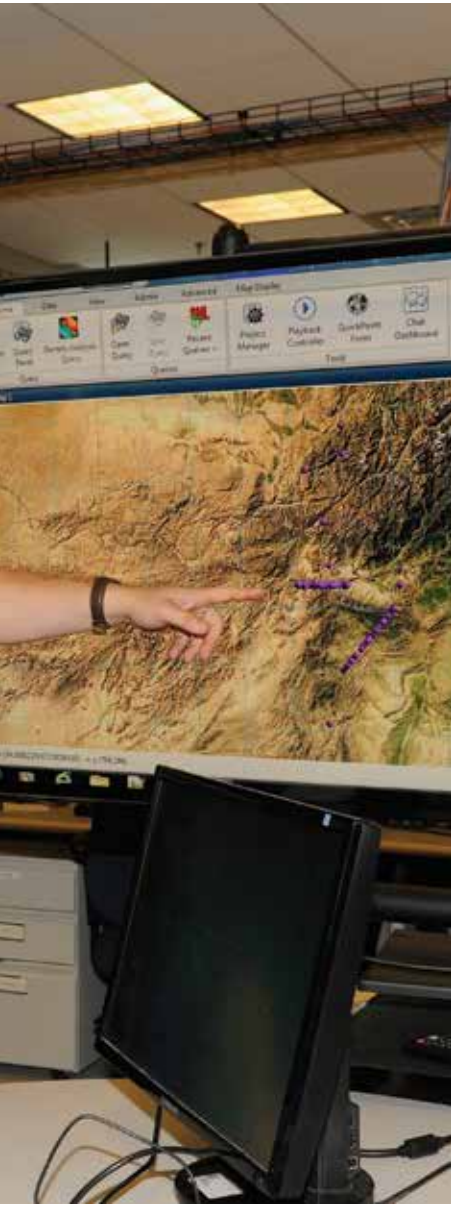
EQUIPMENT/RESOURCES.

- Windows Desktop Computers: 35
- Flat Panel Monitors: 35
- Laptop Computers: 5
- Big Screen LCD/LED TV's: 5
- Windows Computer Servers: 4

CAPABILITIES.

- Technology and application evaluations and experimentation
- Data and scenario generation

Exploitation



- Technology integration
- System administration

EXAMPLES OF CURRENT/PAST PROGRAMS.

- **Machine Reading:** Defense Advanced Research Projects Agency (DARPA) – Establish a test bed for the Machine Reading applications so that the in-house team can conduct evaluations of these unsupervised learning systems to determine performance and gap analysis.
- **GUARD DOG:** DARPA – The plan for the SA Laboratory engineers and analysts is to Test and Evaluate (T&E) the application platforms and technology in support of the program. There will be several different applications and hardware instantiations that will present opportunities for SA Laboratory personnel to contribute to the program.
- **XDATA:** DARPA – Scalable Analytics program to develop technology to leverage large volumes of DoD-data at all stages from analysis to operations.
- **Advanced Information Extraction (IE) and Exploitation Evaluation:** Joint Warfare Analysis Center (JWAC) – Formulate evaluation criteria and identify and evaluate IE and Natural Language Processing (NLP) applications for JWAC. SA Laboratory personnel envision performing the evaluation in classified environments to enable each system to be evaluated with documents representative of those likely to be encountered within JWAC.
- **Developing and Exploiting Behavior Understanding with Layered Sensing (DEBU):** Air Force Research Laboratory (AFRL) Commander's R&D Fund (CRDF) – Establishing in-house test bed to execute research in this cross-directorate CRDF effort. This effort involves Air Force Research Laboratory Information Directorate (AFRL/RI), Sensors (RY), Human Effectiveness (RH), Munitions (RW), and

Please turn page for continuance of current and past programs.

Situation Awareness (SA) Laboratory
continued

Materials & Manufacturing (RX) and is seeking to transition to Air Force Special Operations Command (AFSOC) and U.S. Special Operations Command (SOCOM). The plan is to conduct in-house research in layered network analysis, multilingual text extraction, behavior ontologies, and Moving Target Information Exploitation (MTIX). This research will also include test and evaluation of the individual pieces and a simulation of how they will interact.

- **Extraction from Chat:** National Reconnaissance Office (NRO) - T&E with extraction from chat messages. This will involve developing new rules and scalability testing.
- Advanced Text Exploitation Assistant (ATEA), Text Analysis Technology for Users (TATU), and Enhanced X-Document Consolidation of Entities Extracted from Documents (EXCEED) – data exploitation technology to support user requirements.
- Joint Reserve Intelligence Program (JRIP) – Army and Navy Reserve units that fall under Defense Intelligence Agency (DIA) command.
- ATEA for the Joint Reserve Intelligence Program (JRIP).
- Chat dataset on Sentinel Hawk Video. This dataset was created in support of an Enhanced Exploitation and Analysis Tools (E2AT) briefing in the Corporate Collateral Facility (CCF).
- Creech dataset for the E2AT effort. This dataset consisted of the Creech Chat data and SYCOIN data to make the Creech Video set more realistic. It was then distributed to the E2AT group.
- Monthly Intelligence reports that were disseminated to the Activity Based Analysis (RIEA) and Analytical Systems (RIED) branches.
- Blue Force Over watch scenarios and data for the E2AT project.
- Testing scenarios for the E2AT team using the SYCOIN data sets.
- Usability metrics for testing and evaluation of E2AT developed tools in the K5 laboratory.
- E2AT fusion gazetteer using Google Earth and Keyhole Markup Lanaguage (KML) plug-ins. This tool can be used to fuse collected data and visualize it for analyst dissemination.
- Data Collection - collected common data from several sources that would then be imported into Calspan-University of Buffalo Research Center's (CUBRC) DyGRAF tool for evaluation and dissemination.

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Information Directorate
AIR FORCE RESEARCH LABORATORY








Modeling and Fabrication Shops

RIO Division Office

Providing facilities and services to deliver effective operation support.

MISSION STATEMENT

The Site Operations Division (RIO) sustains and supports installation operations for the Rome Research Site community by delivering quality facilities, environmental services, communication and information systems, logistics activities, force protection, and human resource services, enabling the Information Directorate to develop, field, facilitate and sustain war-winning capabilities and provide effective mission support.

Chief: Dan Bollana
Deputy Chief: Gabe Sbarglia
Supervisor for Fabrication (RIOLF): Frank Giardino

RIO DIVISION OFFICE PHONE: 315.330.2881 / 315.330.4321

Air Force Research Laboratory (AFRL) Modeling and Fabrication Section

Comprised of seven specialty areas and 19 multi-disciplined craftsmen.

DESCRIPTION. The Fabrication Shop produces high quality modifications, fabrications and components to support all facets of research and development and concurrent engineering efforts undertaken by the Air Force Research Laboratory Information Directorate (AFRL/RI).

EQUIPMENT/RESOURCES. The Fabrication facility has complete shops of various trades as well as an expansive high bay and open area to facilitate numerous projects of all sizes and duration. Each trade has a full shop of the latest equipment to handle most any project.

CAPABILITIES. The Fabrication facility has the following capabilities:

- Pattern making
- Woodworking
- Paint
- Plastic fabrication
- Metal machining
- Welding
- Sheet metal work
- Full electric shop

EXAMPLES OF CURRENT/PAST PROGRAMS.

- Rebuilding of a crashed F-22 used for testing purposes
- Joint Strike Fighter
- Predator work
- Replicated various versions of bombs and missiles used in test projects
- Built numerous laboratory spaces for different projects
- Fabricated research test beds using Humvees and Trailers
- Numerous machining projects for laser and camera mounted experiments

Custom

Air Force Technology Transfer (T2)

The Air Force Research Laboratory's Information Directorate (AFRL/RI) emphasizes Technology Transfer (T2) - the sharing or transferring of information, data, hardware, personnel, services, facilities or other scientific resources for the benefit of the private or public sector. The principle types of agreements are described below. Organizations interested in the unique facilities described in this publication can use the contact information on the back cover.

Cooperative Research And Development Agreement (CRADA)

CRADAs CAN BE DEVELOPED WITH?

- A state or local government
- An industrial organization, including corporations, partnerships and industrial development organizations
- Public and private foundations
- Non-profit organizations and Academia

WHAT CAN THE FEDERAL LABORATORY CONTRIBUTE TO THE AGREEMENT?

A federal laboratory may provide, with or without reimbursement

- Personnel
- Services
- Facilities and equipment

Other resources including existing intellectual property and knowledge. A federal laboratory may not provide funds to the collaborating party

WHAT CAN THE FEDERAL LABORATORY RECEIVE IN THE AGREEMENT?

The federal laboratory may accept, retain and use the following provided by the collaborating partner:

- Personnel
- Services

- Facilities and equipment
- Funds and Other resources including existing intellectual property and knowledge

WHAT BENEFIT DOES A CRADA PROVIDE?

- **Benefits to the scientist and engineer**
  - Provides additional resources for your own mission tasks
  - Provides for the sharing of any royalty income received
  - Meets a government mandated effort on technology transfer

- **Benefits to the federal laboratory**
  - Implemented relatively easily and within a relatively short period of time
  - Leverage research and development resources by providing a way to acquire expertise and other forms of assistance, without any monetary payments to a collaborating partner, to further the laboratories mission goals
  - Receive direct payments from the collaborator for use of laboratory resources
  - Provides for sharing between the laboratory and inventor of royalty income received from licensing agreements of CRADA developed technology

- **Benefits to the collaborator**
  - Gains access to federal expertise and obtains rights to technologies developed using federal funds
  - Leverages their research and development resources by providing a way to acquire expertise and other forms of assistance
  - Grant exclusive rights to a federally owned background invention

WHAT IS TYPICALLY INCLUDED IN A CRADA?

- Work Plan – states the nature and scope of the work to be performed
- Financial Obligations – defines what amount of funds, if any, the collaborator will provide to the laboratory
  - Patents – defines the rights of the parties in regard to inventions made by each party and those made jointly during the execution of the agreement
  - Copyrights – defines ownership of copyrighted material
  - Proprietary Information – defines rights and protections afforded to proprietary information brought to the agreement and developed during the execution of the agreement
  - Liability – defines what liability, if any, each party has regarding property, intellectual property, and employees

Commercial Test Agreement (CTA)

A CTA is an agreement where a defense laboratory may make available to any person or entity, at an appropriate fee, the services of any government laboratory for the testing of materials, equipment, models, computer software, and other items.

WHAT ARE THE REQUIREMENTS FOR A CTA?

- Use government facilities on a noninterference basis of the laboratories mission
- Conduct testing that does not constitute undue competition with the private sector
- Use equipment or materials exclusively for research and development; or for use in demonstrations to a friendly foreign government
- Base fees for services not to exceed the amount necessary to recoup the direct and indirect

costs involved, such as direct costs of utilities, contractor support, and salaries of personnel that are incurred by the laboratory to provide for the testing

WHAT ARE THE BENEFITS OF A CTA?

- Perform tests that are confidential and may not be disclosed outside the Federal Government without the consent of the persons for whom the tests were performed
- Provides access to unique research and test support capabilities and facilities

I KNOW OF AN OPPORTUNITY TO DEVELOP A CTA, WHAT NOW?

Contact the directorate's Office of Research and Technology Applications (ORTA) for assistance at AFRL.RI.TT@us.af.mil

Education Partnership Agreement (EPA)

An EPA is a formal agreement between a defense laboratory and an educational institution for the purpose of encouraging and enhancing study in scientific disciplines at all levels of education. Education partnerships are intended to aid in the educational experience of students of all levels by providing a mechanism by which those students can benefit from the staff expertise, unique facilities and equipment that the DOD entity can provide.

WHAT EDUCATIONAL INSTITUTIONS ARE ACCEPTABLE?

- Local educational agency
- Primary and secondary education
- Colleges and universities
- Any other non-profit institutions that are dedicated to improving science, mathematics, and engineering education
- Preference is to be given to primary and secondary schools with mathematics and science education programs to meet the National Education Goals

WHAT CAN BE DONE UNDER AN EPA?

- Loaning laboratory equipment
- Transferring (donating) equipment determined to be surplus
- Making laboratory personnel available to teach science courses
- Making laboratory personnel available to assist in the development of science courses and materials
- Involving faculty/students of an educational institution in laboratory research projects
- Cooperating with an educational institution in developing a program under which students may be given academic credit for work on laboratory research projects
- Providing academic and career advice and assistance to students of an educational institution

BENEFITS TO THE DEFENSE LABORATORY

- Involving students in the laboratories develops a future pool of scientists and engineers
- Increases awareness and visibility of military developed technologies
- Increased potential for commercializing military technology

BENEFITS TO THE EDUCATIONAL INSTITUTION

- Receive equipment that it could not afford to purchase
- Provide opportunities for students and faculty to work on defense research projects
- Improve students interest in math, science and technology

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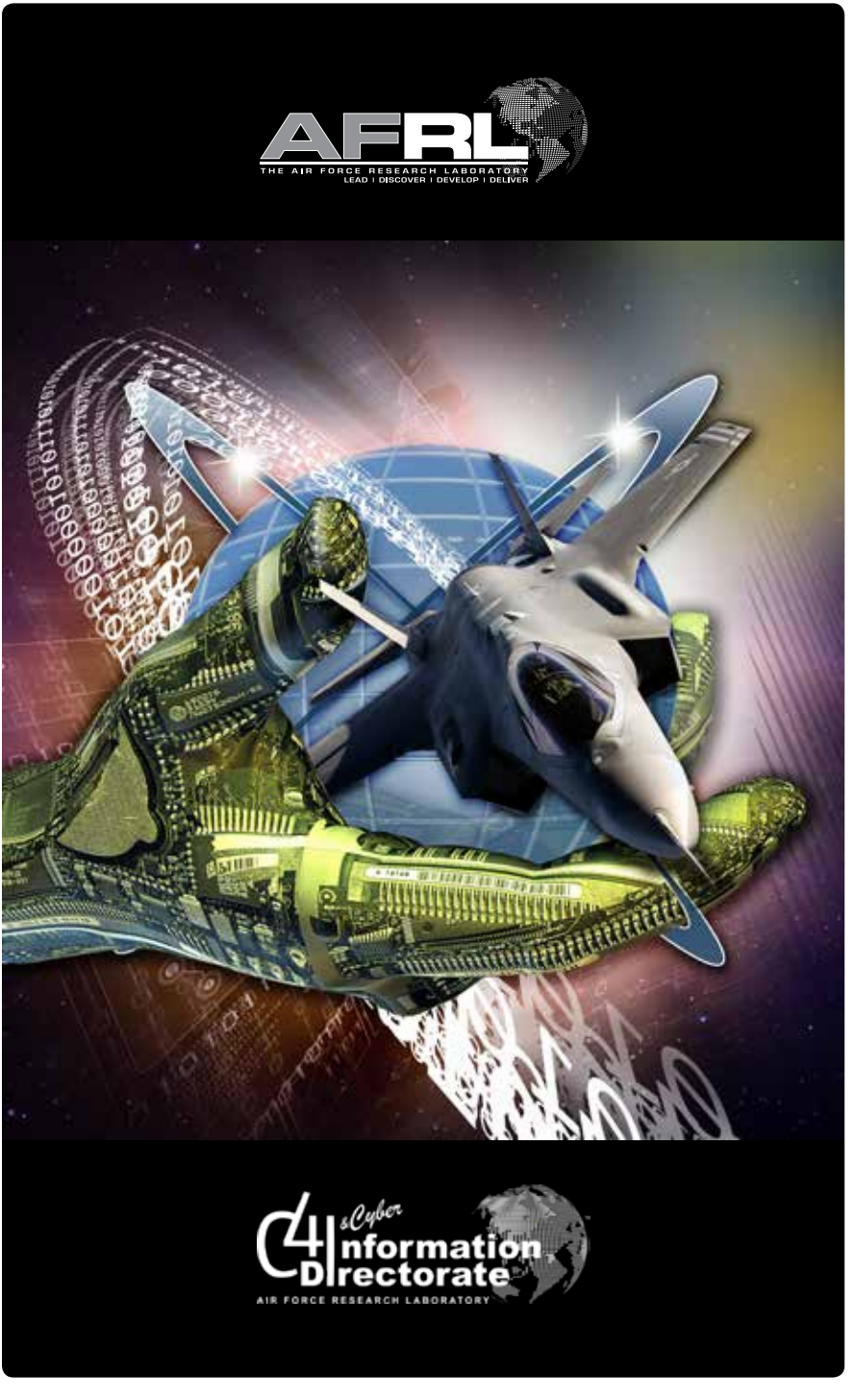
Notes: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